CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The study is made at the milling laboratory, at Faculty of Manufacturing Engineering (*FKP*). All the process to make the device such as make a program to connect and control all the electronic devices including liquid pump, ultrasonic sensor and program the Arduino board will be made in the electric and electronic lab at *FKP*. This project focuses on two main liquid substances that are currently available and used widely at milling lab which are hydraulic fluid and cutting fluid. The new upcoming liquid substances for the manufacturing lab is not including in the project.

This project is divided into three phases based on Figure 3.1 Phase I is designing the system, programming for Phase II and building circuit and hardware for Phase III. In Phase I, the types handling device are identified and designing processes on how the systems worked on. By knowing the objectives and flow of the system, the selection of the materials and electronic components is made. The device system is planned on having two ways of handlings, manually and automatically and each of them is for different purposes.

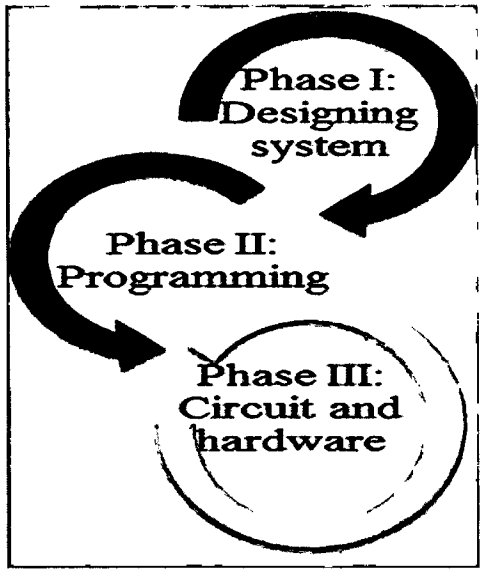

Figure 3.1: Main phase of the methodology

Firstly, the device is designed for removing liquid substances from the tank into the other containers manually. The capacity of the liquid in tank continuously been updated on the liquid-crystal display (LCD) when it get feedback from the ultrasonic sensor. Indicators also are used to give visual alarm to the users about the capacity of the liquid. The liquid is pumped out using a single stage centrifugal pump, which is using direct power source. Secondly, the device is designed for refilling process where liquid substance is been filled into the tank from the other source, which is done automatically. The process is controlled by the ultrasonic sensor, where it gives signal to the pump by monitoring the capacity of tank. The pump shuts off by itself when the capacity of the liquid is 100 per cent and is displayed on the LCD. The method used in convert the volume of the liquid in the tank is shown in Appendices A.

On Phase II, programming is made to connect Arduino board circuit to the single stage centrifugal pump, liquid-crystal display (LCD), switches, indicators and ultrasonic sensor. The program is computed using Arduino IDE software, using programming language C. The programming analyses and gives command to the electronics components to function. It is computed using Arduino IDE software. Then, the electronic devices are set up by design that has been made in Phase I and making the schematic diagram using Proteus software.

For Phase III, all of the electronic components are connected to the Arduino board and the programming is burned into the board system. The Arduino board, indicators and switches are placed in a box casing to avoid splashes of the liquid substances and the pump and ultrasonic sensors also are set up on the prototype container that is act as the liquid storage tank which is equipped with the piping system.

After the handling device been made, and the level system is applied to the device, a few tests are run to compare the result based on those two variables which are Coolegde BI and Tellus 68. The first experiment is to compare the result of using LDH and RHDP in transfer out liquid from tank. The liquids are compared between their speed and time taken to achieve certain fixed volume. Second experiment is calculating the speed of RHDP by revolution per second. The speed of RHDP is based on the effort applied by users. Third is efficiency experiment where speed of refilling liquid process will be depends on the ultrasonic sensor. This experiment is to observe the sensibility of the ultrasonic sensor used.

3.2 PHASES

3.2.1 Phase 1: Designing of System

Designing is a significant activity because it has been estimated the cost of product development and manufacture is determined by the decisions obtained in the beginning design stages. The design process starts with the development of an original product concept. The initial concept of this study is creating a liquid handling device that can give multi functions and reduces wastes related to the liquid substances that occur in the milling lab of *FKP*.

A well designed product should be functional, well manufactured in production, well packaged, its functions affectively for its intended purpose, has components that easily replaced, repaired or maintained and resource efficiently (Kalpakjian et al, 2006). The design also must compatible with the environment of the study case, where in this study; it can be used using several types of liquid substances.